SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING DECEMBER, 1930

By HERBERT H. KIMBALL

For reference to description of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this volume of the REVIEW, page 26.

Table 1 shows that solar radiation intensities averaged above the normal intensity for December at Washington, D. C., and Lincoln, Nebr., and slightly below normal at Madison, Wis.

Table 2 shows an excess in the total solar radiation received on a horizontal surface directly from the sun and diffusely from the sky at Washington, New York, and Fresno, and a deficiency at Madison, Lincoln, Chicago, and La Jolla.

For the year, as shown in the last line of Table 2, there have been unimportant percentage departures in the total radiation received, except at Washington, where there was an excess of 6.9 per cent, and at La Jolla, where there was a deficiency of 1.5 per cent, as compared with the annual average at the respective stations.

Skylight polarization measurements were obtained at Washington on 3 days, and give a mean percentage of 58, with a maximum of 62 on the 16th. At Madison, measurements were obtained on the 9th only, and gives a percentage of 72. Snow covered the ground throughout the month at this station except from the 5th to the 12th. At both stations the measurements obtained are close to average values for December at the respective stations.

TABLE 1.—*Solar radiation intensities during December, 1930*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Dec. 2	1.19		0.84	1.08	1.28			1.06	0.89	0.80	1.02
Dec. 3	2.16	0.90	0.95	1.10	1.29		1.29	1.10	0.96	0.84	1.88
Dec. 16	1.07	0.99	1.16	1.25	1.37		1.37	1.23	1.06	0.93	2.49
Dec. 18	2.87				1.26						1.52
Dec. 21	3.15				1.32						4.17
Dec. 23	2.74				0.91						2.74
Means		(0.94)	0.98	1.14	1.24		(1.33)	1.13	0.97	0.86	
Departures		+0.15	+0.08	+0.09	+0.01		+0.01	+0.10	+0.06	+0.06	

Madison, Wis.

Dec. 1	1.02	1.06	1.20	1.29							0.51
Dec. 8	3.30							0.98			3.99
Dec. 9	3.99	0.93	1.05	1.18				1.22			4.37
Dec. 15	1.52	0.89	1.16	1.30							1.68
Dec. 16	1.32	0.93	1.12	1.30							2.06
Dec. 17	1.37	0.72	0.85	1.01							1.96
Dec. 23	1.78			1.30							1.68
Dec. 30	1.19		1.14	1.21							1.12
Dec. 31	3.45							1.27			1.45
Means		0.91	1.09	1.23				1.16			
Departures		−0.05	−0.01	+0.02				−0.08			

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during December, 1930*—Con.

Lincoln, Nebr.

Date	Sun's zenith distance: 8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Dec. 8	3.15	0.71	0.91	1.09				1.21	0.96	0.89	4.57
Dec. 10	4.17							1.27	1.09	1.02	4.57
Dec. 11	3.15	0.98	1.07	1.22							3.45
Dec. 19	2.62		1.12	1.35							3.00
Dec. 23	2.49		1.05	1.22							3.63
Dec. 28	2.26			1.24				1.12			3.00
Dec. 29	2.87		1.13								3.00
Dec. 30	1.78		1.05	1.20				1.24			2.49
Dec. 31	2.87		1.22	1.34				1.35	1.18	1.05	2.87
Means		(0.84)	1.08	1.24				1.24	1.08	0.99	
Departures		−0.11	−0.02	+0.03				+0.08	+0.01	+0.03	

TABLE 2.—*Total solar radiation (direct+diffuse) received on a horizontal surface*

GRAM-CALORIES PER SQUARE CENTIMETER

Week beginning—	Average daily totals: Washington	Madison	Lincoln	Chicago	New York	Pittsburgh	Gainesville	Fresno	La Jolla	Miami
1930	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Dec. 3	141	87	129	36	79	80	210	214	234	280
Dec. 10	159	101	138	53	105	54	213	214	262	289
Dec. 17	154	116	169	51	106	38	92	231	271	198
Dec. 24 [1]	147	111	184	67	89	74	190	200	233	224
	Departures from weekly normals									
Dec. 3	−6	−34	−40	−34	−10			+25	−39	
Dec. 10	+20	−11	−19	−16	+16			+35	−15	
Dec. 17	+12	−7	−3	−25	+12			+58	−3	
Dec. 24	+5	−16	+3	−15	−9			+38	−17	
Accumulated departure at end of year	+8,405	+1,314	−808	+34	+1,230			−1,006	−1,947	
Percentage departures for the year	+6.9	+1.1	−0.6	±0.0	+1.3			−0.6	−1.5	

[1] 8-day means.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, Superintendent United States Naval Observatory. Data furnished by Naval Observatory, in cooperation with Harvard, Yerkes, Perkins, and Mount Wilson Observatories. The differences of longitude are measured from central meridian, positive west. The north latitudes are plus. Areas are corrected for foreshortening and are expressed in millionths of sun's visible hemisphere. The total area, including spots and groups, is given for each day in the last column]

Date	Eastern standard civil time	Heliographic: Diff. long.	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day
1930	h m	°	°	°			
Dec. 1 (Naval Observatory)	12 23	−5.0	37.8	+8.0	46		
		+17.0	59.8	+8.5		15	
		+37.5	80.3	+14.5		170	
		+63.5	106.3	−9.0		309	540
Dec. 2 (Naval Observatory)	12 32	+8.0	37.5	+9.0		77	
		+56.0	85.5	+14.0		93	
		+77.0	106.5	−9.0		309	479

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic Diff. long.	Heliographic Longitude	Heliographic Latitude	Area Spot	Area Group	Total area for each day
1930	h m	°	°	°			
Dec. 3 (Naval Observatory)	11 45	+20.5	37.3	+9.0	------	93	------
		+71.0	87.8	+14.0	------	93	186
Dec. 4 (Naval Observatory)	10 47	+33.5	37.6	+8.5	------	93	------
		+75.5	79.6	+16.5	------	46	139
Dec. 5 (Mount Wilson)	12 50	+49.0	38.9	+9.0	------	32	32
Dec. 6 (Mount Wilson)	13 40	+60.0	36.2	+10.0	9	------	9
Dec. 7 (Mount Wilson)	12 30	+80.0	43.6	+9.0	16	------	16
Dec. 8 (Naval Observatory)	10 46	------	------	------	------	------	(*)
Dec. 9 (Naval Observatory)	13 33	−74.0	222.7	+5.0	------	170	170
Dec. 10 (Perkins Observatory)	11 37	−64.5	220.2	+5.0	------	186	186
Dec. 11 (Mount Wilson)	14 0	−55.0	215.2	+3.0	------	11	------
		−48.0	222.2	+11.0	------	5	------
		−48.0	222.2	+5.0	83	------	------
		−37.0	233.2	+17.0	------	9	108
Dec. 12 (Naval Observatory)	11 5	−37.0	221.6	+6.5	------	93	------
		−36.0	222.6	+10.5	15	------	------
		+26.0	284.6	+11.5	9	------	117
Dec. 13 (Naval Observatory)	11 40	−22.5	222.6	+6.0	------	123	123
Dec. 14 (Mount Wilson)	14 10	−16.0	214.5	+6.0	14	------	------
		−5.0	225.5	+6.0	------	80	------
		+10.0	240.5	−12.0	------	90	184
Dec. 15 (Naval Observatory)	11 44	+7.0	225.7	+6.5	19	------	------
		+21.5	240.2	−12.0	------	77	96
Dec. 16 (Naval Observatory	11 57	+32.0	237.4	−11.0	31	------	------
		+38.5	243.9	−14.0	------	62	93
Dec. 17 (Yerkes Observatory)	12 43	−75.0	116.8	−7.1	260	------	------
		−67.8	124.0	−8.6	266	------	526
Dec. 18 (Naval Observatory)	11 10	−69.5	110.0	−10.0	62	------	------
		−55.0	124.5	−11.5	------	31	------
		+48.0	227.5	+12.0	31	------	------
		+60.0	239.5	−12.0	------	31	------
		+67.5	247.0	−13.0	------	31	186
Dec. 19 (Mount Wilson)	14 45	−82.0	82.4	+17.0	19	------	------
		−55.0	109.4	−9.0	162	------	------
		−49.0	115.4	+10.0	------	30	------
		−41.0	123.4	−11.0	------	11	------
		−26.0	138.4	−8.0	------	4	------
		+61.0	225.4	+11.0	------	166	------
		+80.0	244.4	−15.0	------	30	422
Dec. 20 (Naval Observatory)	13 54	−40.0	111.6	−9.0	123	------	------
		−33.0	118.6	+10.0	31	------	154
Dec. 21 (Naval Observatory)	11 10	−29.0	110.9	−9.5	------	108	------
		−21.0	118.9	+9.0	15	------	123
Dec. 22 (Naval Observatory)	11 49	−39.5	86.9	+12.0	31	------	------
		−12.0	114.4	−9.5	------	108	------
		−9.5	116.9	+9.8	31	------	170
Dec. 23 (Naval Observatory)	11 28	−1.5	111.9	−9.5	------	108	------
		+30.0	143.4	+2.0	------	62	170
Dec. 24 (Naval Observatory)	11 9	−16.5	83.9	+15.0	31	------	------
		−11.5	88.9	+13.0	------	62	------
		+12.5	112.9	−8.5	------	77	170
Dec. 25 (Naval Observatory)	11 5	+2.5	89.8	+13.0	------	62	------
		+6.5	93.8	+16.0	45	------	------
		+26.0	113.3	−8.5	------	31	138

* No spots.

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard civil time	Heliographic Diff. long.	Heliographic Longitude	Heliographic Latitude	Area Spot	Area Group	Total area for each day
1930	h m	°	°	°			
Dec. 26 (Mount Wilson)	14 15	−52.0	20.4	+10.0	------	6	------
		−33.0	39.4	+9.0	------	6	------
		+5.0	77.4	+19.0	------	4	------
		+17.0	89.4	+14.0	------	115	------
		+39.0	111.4	+7.0	5	------	------
		+39.0	111.4	−9.0	------	4	140
Dec. 27 (Naval Observatory)	12 46	−32.0	28.0	+11.5	------	108	108
Dec. 28 (Mount Wilson)	13 0	+45.0	91.7	+13.0	72	------	72
Dec. 29 (Naval Observatory)	12 33	+68.5	102.3	+17.0	46	------	46
Dec. 30 (Naval Observatory)	10 45	+70.0	91.6	+17.0	------	62	62
Dec. 31 (Naval Observatory)	11 17	------	------	------	------	------	(*)
Mean daily area for December							160

* No spots.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR DECEMBER, 1930[1]

[Data furnished through the courtesy of Prof. W. Brunner, University of Zurich, Switzerland]

December, 1930	Relative numbers	December 1930	Relative numbers	December, 1930	Relative numbers
1	a 47	11	21	21	c 35
2	36	12	------	22	28
3	35	13	15	23	a 31
4	21	14	22	24	45
5	8	15	a 22	25	a 52
6	8	16	20	26	53
7	7	17	d 30	27	41
8	c	18	d 52	28	26
9	E 8	19	Wcc 50	29	9
10	19	20	42	30	15
				31	14

Mean: 28 days=28.0.

[1] Dependent alone on observations at Zurich and its station at Arosa.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a large or average-sized center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central zone.
d=Entrance of large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

By L. T. SAMUELS

Free-air temperatures during December were below normal at all stations except from the surface to 2,000 meters at Ellendale. (See Table 1.) The largest departures occurred at Due West and Groesbeck.

The free-air relative humidities were mostly above normal with the largest departures occurring in the higher levels at Ellendale.

Free-air vapor pressures, in agreement with the temperatures, were below normal at all stations except Ellendale, with the largest departures occurring at Due West and Groesbeck.

It is interesting to note that notwithstanding the supernormal relative humidities and vapor pressures at Ellendale, the total precipitation for the month was the lowest of record (14 years), being only 0.07 inch. However, the month had 15 cloudy and 10 partly cloudy and 6 clear days.

Free-air resultant winds for the month at the 1,000-meter level contained a pronounced westerly component at all stations east of the Rockies and north of latitude 30°. The resultant velocities ranged from 4 meters per second in the southern section to 8 meters per second in the north. Along the Pacific coast and northern Rocky Mountain region the resultant winds were variable and the velocities mostly light.

At 3,000 meters a westerly component prevailed at all stations, including Key West, with the highest resultant velocities in the north-central portion of the country.

The monthly resultants for a representative group of stations are shown in Table 3.